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SACLANT ASW RESEARCH CENTRE MEMORANDUM

THE SACLANTCEN OCEANOGRAPHIC DATA BASE
VOL. I: DESIGN CRITERIA AND DATA STRUCTURE AND CONTENT

by

RICHARD F.J. WINTERBURN

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VOL. I: DESIGN CRITERIA AND DATA STRUCTURE AND CONTENT.

by

10 Richard F.J. Winterburn

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This memorandum has been prepared within the SACLANTCEN Underwater Research Division as part of Project 01.

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O.F. Hastrup
O.F. HASTRUP
Division Chief

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THE SACLANTCEN OCEANOGRAPHIC DATA BASE
VOL. I: DESIGN CRITERIA AND DATA STRUCTURE AND CONTENT

by

Richard F.J. Winterburn

ABSTRACT

An oceanographic data base established at SACLANTCEN on an 'in-house' UNIVAC 1106 computer system is described. Volume I discusses the design criteria used in setting up the data base, lists its structure and content, and explains how acquired data, either from outside institutions or from SACLANTCEN experiments are re-formatted and entered. Volume II describes how data are accessed, interrogated, and displayed, including the plotting of charts with coastlines and of contoured data.

INTRODUCTION

In 1973 the results of a preliminary statistical analysis of the variability of critical depths in the Mediterranean was presented <1> at a conference on Deep Active Sonar held at SACLANTCEN. The promising nature of these results prompted an 'in-depth' study of this phenomena to be conducted by SACLANTCEN's Military Oceanography Support project. A pre-requisite for this study was the acquisition of a large data set of historical Nansen cast profiles from the Acoustic Environmental Support Detachment of the U.S. Office of Naval Research and subsequently (1974) of BT and XBT profiles from the U.S. Naval Oceanographic Office. A report <2> on the study was published in 1977.

In 1976, part of the programme of SACLANTCEN's Underwater Research Division directed attention to areas outside the Mediterranean Sea, viz. the Western Approaches to Gibraltar, the Gulf of Cadiz, and the Southwestern Approaches to the English Channel. As a result, the store of data was augmented with the inclusion of BT, XBT, and Station data from the eastern North Atlantic.

These data thus formed the core of the Oceanographic Data Base (known by the acronym SMODS - SACLANTCEN Military Oceanographic Data Support), which was later enhanced with data collected during SACLANTCEN experiments in the Mediterranean and eastern North Atlantic to become a basic research tool available at SACLANTCEN for the research programmes. The present memorandum, which is the first of two volumes on the subject, discusses the design criteria used in setting up this data base (Ch. 1), lists the structure and content of the base (Ch. 2), and explains how data are reformatted and entered (Ch. 3). A second volume <3> describes how the data are accessed, interrogated, and displayed.

1 DATA-BASE DESIGN

1.1 General

This is a subject on which a plethora of literature is available, from which much counsel - wise and unwise - may be derived. From this, one common advice emerges: that time spent in the design phase is time well spent. State-of-the-art methods in data-base design are still essentially trial and error. The task of the data-base designer is to minimize as far as possible the remedial measures necessary to redesign the system at some later date.

It has been stated <4> that the goal of successful data-base design is to provide a model of the application environment that accurately reflects the user's view of the data and also enables data to be stored and accessed efficiently. In the design phase, the structuring of the data is one problem, but this structure will be derived within the constraints of the hardware (physical equipment) on which it is to be implemented and the software (computer programs) to be used to manipulate it.

There are therefore several factors to be taken into account, including:

a. The creation of a data structure that, as closely as possible, models the required logical relationships between data sets.

b. The logical relationships thereby modelled should reflect the mutually dependent attributes within the data on which the access and application of the data base will depend.

c. The designed logical structure should allow a physical implementation that makes optimum use of available hardware and data management software.

d. As far as possible, future developments in terms of content, organization and application must be foreseen.

e. The designed structure should, as far as possible, be transparent to the user. In a research community, the scientist or scientific programmer should be able, by means of a simple interface routine to access any record within the data base without prior knowledge of its position within the logical or physical society of which it is a member.

At the time of the initial development of the SMODS data base, excessive overheads of time, manpower and computer resources prevented the implementation of the UNIVAC DMS 1100 DBMS package as the basis of data management at SACLANTCEN. In its place an in-house file manager was developed <5> of far less complexity but with far fewer facilities, which imposed severe restrictions on the design possibilities. However, recent developments show that for future research applications a more flexible storage system will be required. As was stated earlier, the successful design of a data base is an iterative process, where experience with the data clarifies discrepancies and shortcomings within the accessing system. Within a research establishment such as SACLANTCEN, the constant turnover of scientific personnel with diverse international and professional backgrounds injects a continuous stream of new ideas for the 'navigation' and application requirements of the data base.

The initial requirements were to retrieve individual members of a data set, given that oceanographic domain and season of measurement were to be the parameters of highest priority. The initial design was created using the hardware available at that time (i.e. no removable disks) and the data-management software. Subsequently, applications have demanded a more extensive search parameter list, and changing areas of research interest have vastly increased the content in terms of both quantity and type of data. For these reasons the data base was subsequently restructured to its present form. Since that time (1977) many additional data have been entered into the base but no alterations have been made to the structure whatsoever.

1.2 Logical Structure

The Mini-Filing System (MFS) <5> is designed on a three-level hierarchical structure determined by the operating system executive (EXEC-8) organization of a file/element relationship giving random access to any individual element: i.e. the basic unit of data is an element, a number of which may be grouped together as a file. These elements may be changed, augmented, or deleted rather like the pages of a loose-leaf book, where the book is the EXEC-8 file and the pages are the elements. Using this analogy one can also visualize having empty files (i.e. the book is ready to receive pages but none has as yet been inserted), which will be shown to be necessary at the initial loading stage of data entry.

The MFS enables the file names to be encoded as character strings, which allows the creation of additional pseudo-levels by subdividing the MFS-level names; individual data records within the fields of the particular keys are thus defined as elements of that file. In this way the problem of storage and retrieval of a given data set becomes that of the parameterization of a file/element name. By creating a conceptual five-level tree structure (Fig. 1) the SMODS data are referenced by their encoded names (Fig. 2). The key parameters have been selected both for their relative importance in terms of frequency of access (Marsden square* and month) and within the constraints of the relative size of the data sets (instrument).

Thus the identity of an element containing a particular profile is created by a catenation of its Instrument Code, Marsden Square reference, one degree square, month, and consecutive number.

For example, in Fig. 1, XBT (n) is identified by

INSTRUMENT .... MPGXBT

Marsden Sq. 145

1° Square 97

Month .... 4 (April)

Consec. No. 1

*The Marsden system of dividing the earth's surface divides it into "squares" bounded by meridians and parallels at intervals of 10°, these being known as Marsden squares and having unique numbers. Each Marsden square is further subdivided into four 5° sub-squares (which are lettered but are not used here) and 100 1° sub-squares, which are also numbered (see Fig. 3).

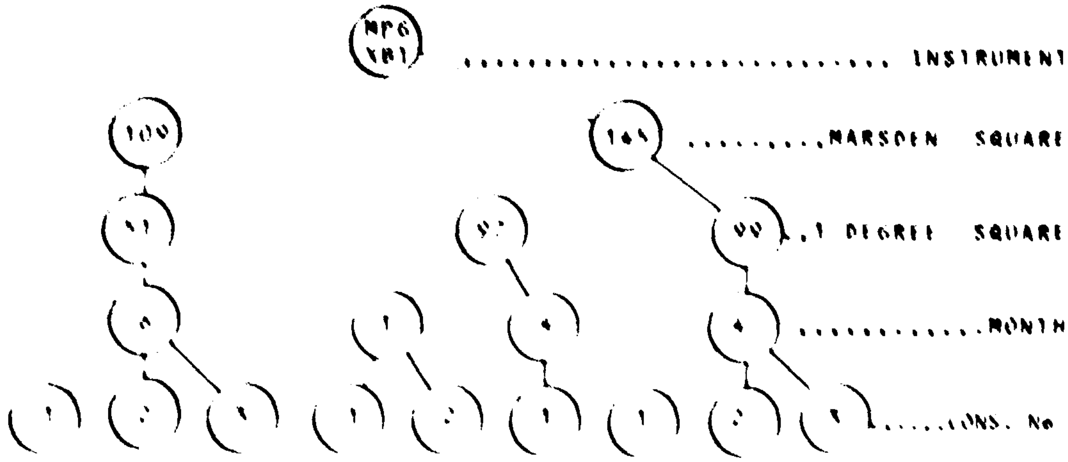


FIG. 1 INVENTORY DATA 5 LEVEL HIERARCHY

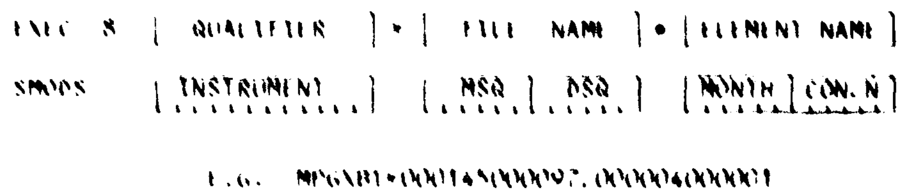
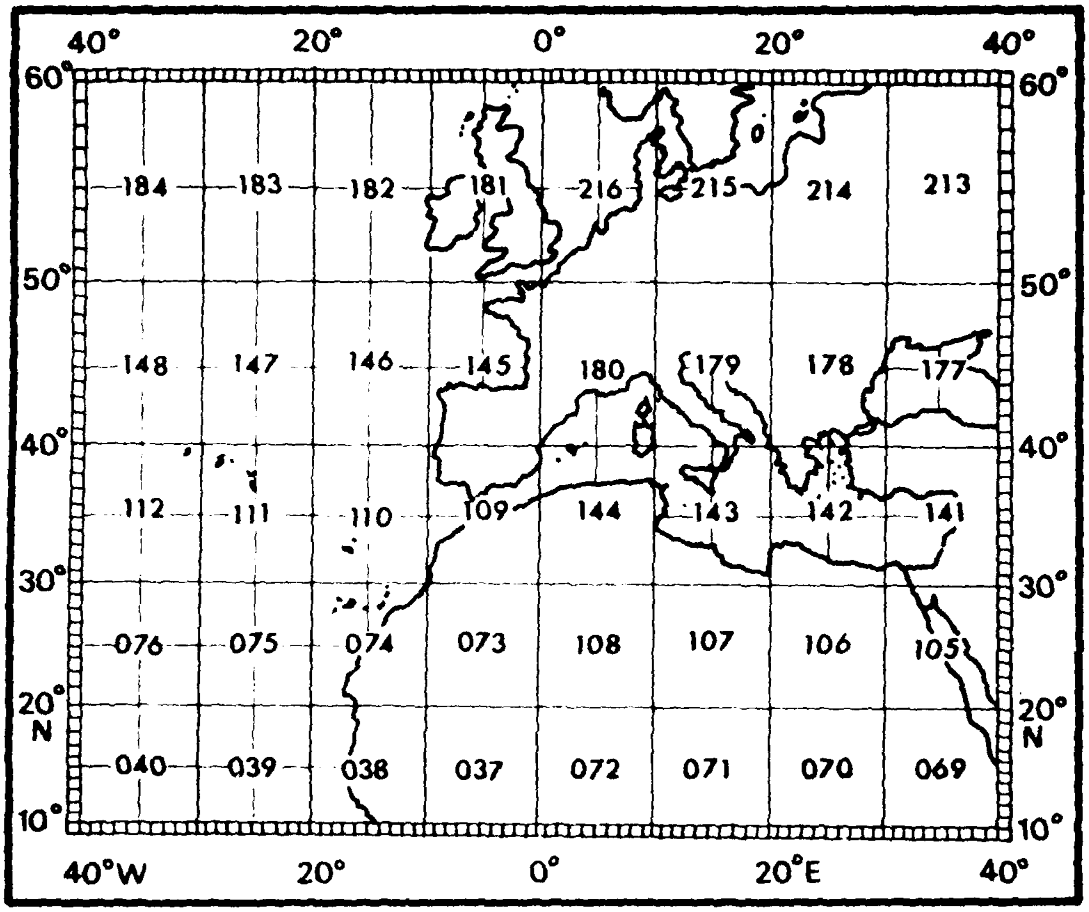


FIG. 2 RELATIONSHIP OF ACCESS PARAMETERS TO FILE ELEMENT NAMES



1° SQUARE IDENTIFICATION
NORTHERN HEMISPHERE

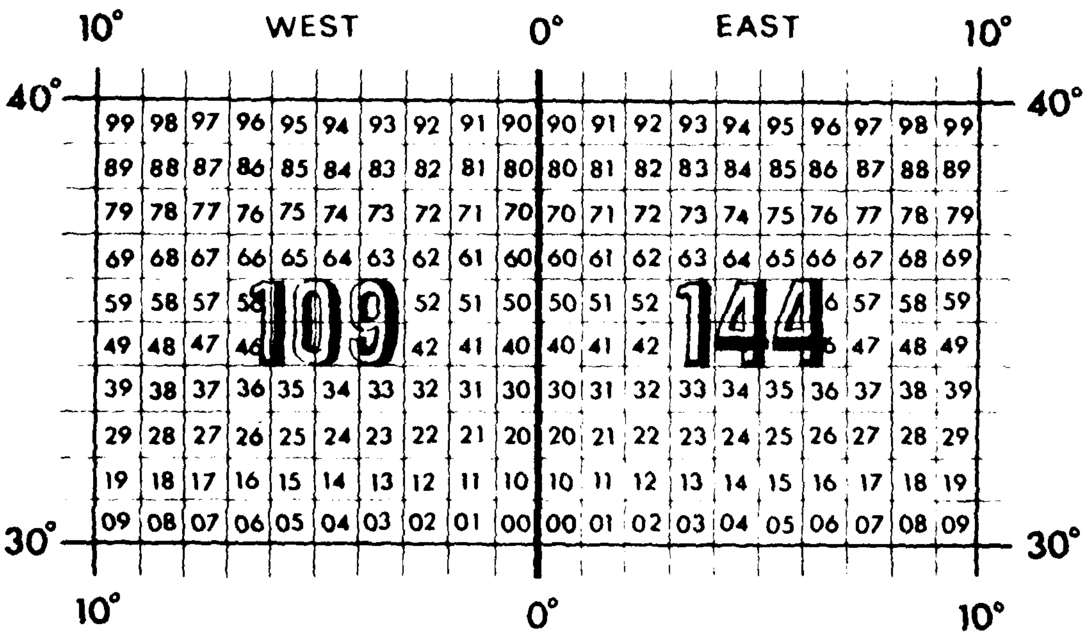


FIG. 3 MARSDEN SQUARE IDENTIFICATION

and therefore, as shown in Fig. 2, this would be stored in the EXEC 8 file/element

MPGXBT*000145000097.000004000001

Thus each profile may be uniquely identified and accessed directly by means of its EXEC-8 element address.

1.3 Physical Structure

Using this structure, the SMODS data base is stored within 1340 EXEC-8 files, the largest number of elements within any one file being 1736. With the present configuration at SACLANTCEN (Fig. 4), where data from each type of instrument are on a dedicated removable disk pack (UNIVAC model 8414), they may be manipulated either 'en-masse' by the EXEC-8 'SECURE' processor or individually by the MFS interface routines called by user's application software.

The present size of the data base in terms of physical storage is summarized in Table 1 and approximates 79 megabytes (1 bite = 6 bits). This table clearly indicates the disparity in the space used by different instrument types. The last column shows that the digital STD data of instrument 7 use far more space than the others. Even though compressed from their original scan values, they still occupy ten to twenty times the space required by the BT data. This is discussed in greater detail in later chapters.

TABLE 1

PRESENT DISK CAPACITY OF THE SMODS DATABASE

Instrument	No. of Files	No. of Elements	No. of Words	Average Words/Profile
1	379	16 756	4 198 654	250.58
2				
3	310	9 289	2 464 000	265.26
4	244	23.808	2 944 256	123.67
5	398	11 473	3 121 664	272.09
6	10	248	64 624	260.50
7	25	189	464 716	2458.80
TOTAL	1366	61 763	13 257 916	214.60

1.4 Data Independence

Data independence has been defined <6> as "the concept of separating the definitions of physical and logical data, such that application programs do not depend on where or how physical units of data are stored". However, in

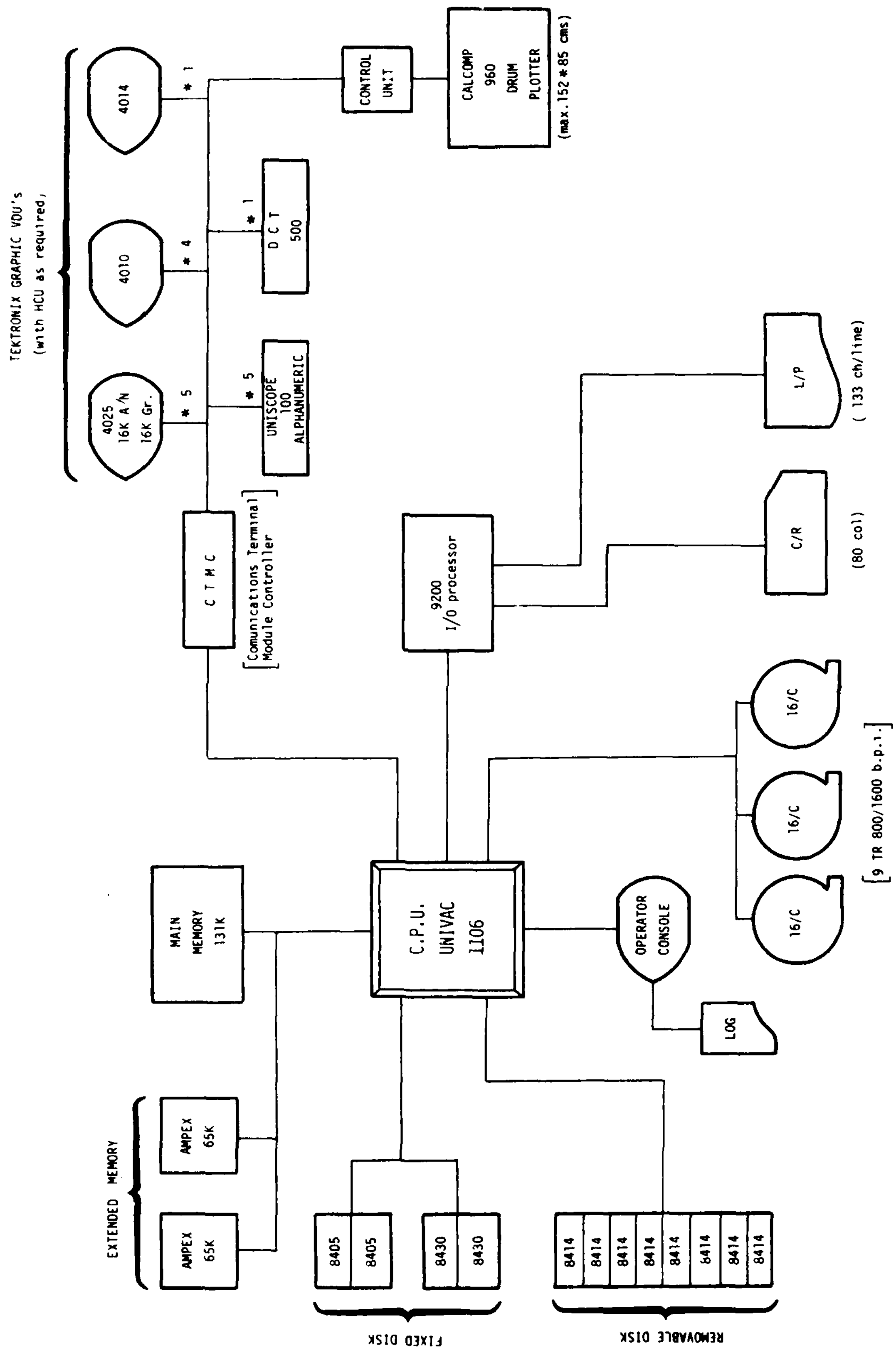


FIG. 4 SACLANTCEN COMPUTER CONFIGURATION

terms of execution time when retrieving data, it can be expedient to design application programs that bear in mind the physical separation of the data that is enforced by limitations in mass-storage capability.

The MFS allows the data base to be truly independent, in as much as the merging of new data into the data base, or the updating or deletion of existing data is entirely independent of the accessing programs, which require no modification after such changes. In addition, the physical location of the data on mass storage is immaterial to the access software.

1.5 Data Integrity and Access Control

All files in the MFS are also entered in the system's Master File Directory (MFD), as normal EXEC-8 files, and as such there is complete inhibition of accidental overwriting. The use of access keys on the file names is known only to the data-base administrator and new data are input only under his auspices, thereby maintaining the necessary quality control and security.

Because they are considered as normal files, multiple concurrent access is possible to the same file, exclusive assignment to one user being given only during an update.

Total data-base integrity is maintained by a magnetic-tape copy of each disk, both before and after the latest update; in this way the data base can be recovered to the previous version.

2 DATA-BASE CONTENTS

2.1 General

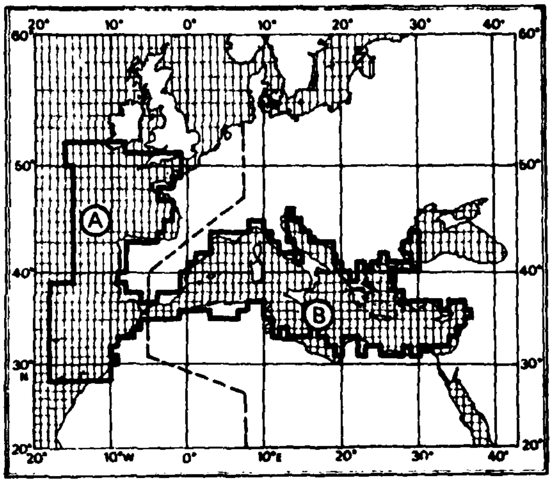
Most of the present data base consists of data acquired from external sources. As the geographical areas of interest of the various research projects within SACLANTCEN have diversified, additional historical data have been acquired and merged into the data base. In addition, software has been developed for the entry of digital data acquired on the Centre's research vessels. This is now available for expendable bathythermograph (XBT) and STD data; in the future it will also encompass CTD, current meter, and possibly sea-surface temperature data interpreted from satellite infrared-image processing.

2.2 Data Sources and Spatial Coverage

The data included at present are bathythermograph data (BT, XBT, and AXBT), serial station data (Nansen casts and a small number of significant-point STD profiles), and digitally recorded STD data.

Their spatial coverage, sources, and currency dates where applicable (i.e. the date of extraction from the source files), are shown in Figs. 5(a), (b) and (c).

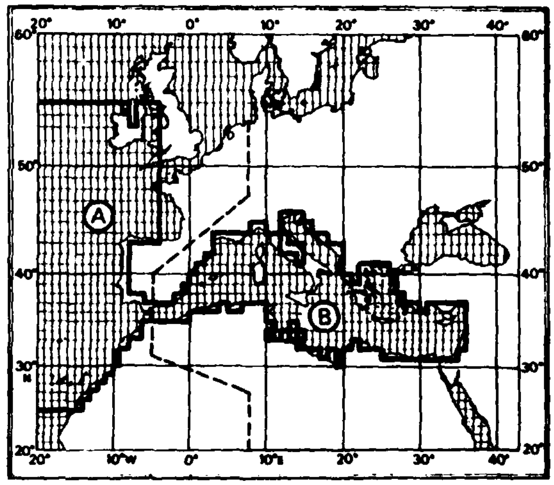
Figures 6(a), (b), (c) and (d) shows the number of profiles for each instrument type per Marsden square at the time of writing (Aug 1980). These totals are very quickly outdated and therefore should be used only as



A) U.K. HYDROGRAPHIC OFFICE M.O.D. (N) TAUNTON, U.K., 6 DEC 1977

B) FLEET NUMERICAL WEATHER FACILITY, MONTEREY/U.S. NAVAL OCEANOGRAPHIC OFFICE D.C. 17 JUNE 1974

FIG. 5(a)
EXTERNALLY ACQUIRED BT DATA
Spatial coverage
Sources and supply data



A) U.S. NAVAL OCEANOGRAPHIC OFFICE, D.C. 2 MAY 1977

B) ACOUSTIC ENVIRONMENTAL SUPPORT DETACHMENT O.N.R. WASHINGTON D.C. 1 NOV 1973

FIG. 5(b)
EXTERNALLY ACQUIRED NC DATA
Spatial coverage
Sources and supply data

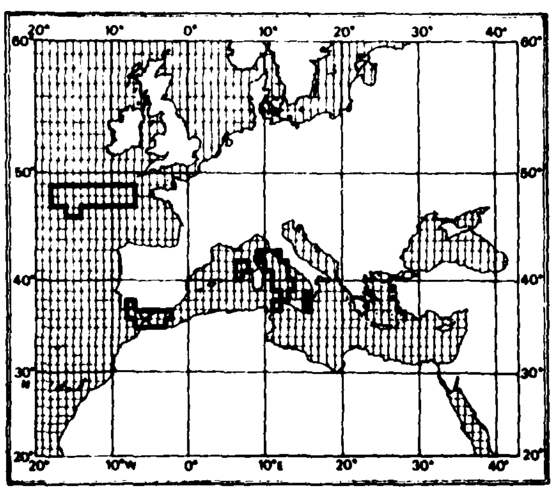


FIG. 5(c)
INTERNALLY ACQUIRED BT AND STD DATA
Spatial coverage

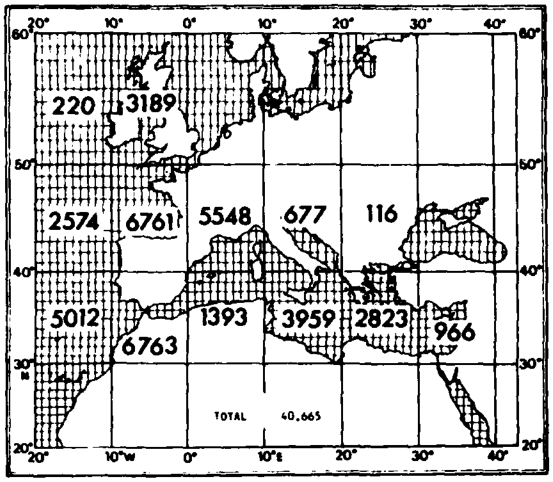


FIG. 6(a)

EXTERNALLY ACQUIRED BT DATA
No. of profiles per Marsden square

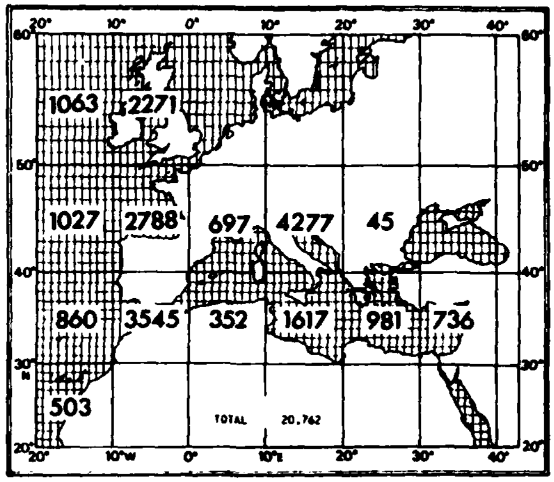


FIG. 6(b)

EXTERNALLY ACQUIRED NC DATA
No. of profiles per Marsden square

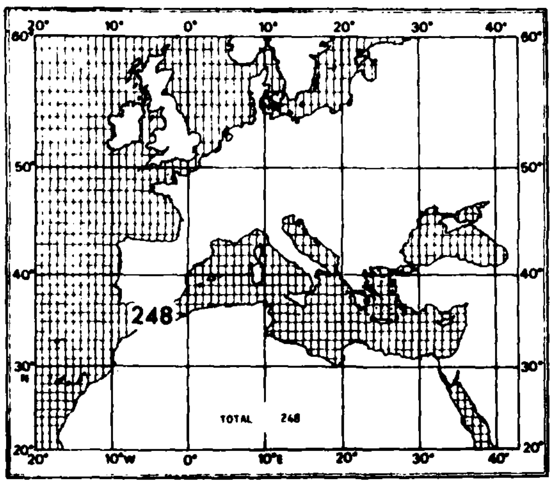


FIG. 6(c)

INTERNALLY ACQUIRED BT DATA
No. of profiles per Marsden square

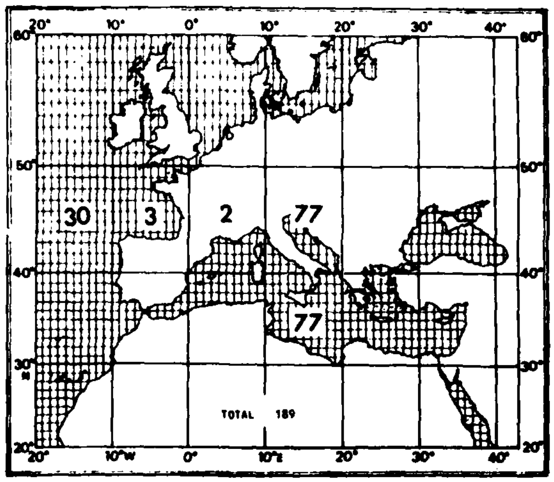


FIG. 6(d)

INTERNALLY ACQUIRED STD DATA
No. of profiles per Marsden square

a guide. A large effort is at present being devoted to inputting all historical SACLANTCEN data from the Mediterranean and Atlantic areas and these totals are therefore being augmented daily. Table 2 details the distribution of instrument data by ocean area, using 5°W as the division between Atlantic and Mediterranean.

TABLE 2

CONTENTS OF THE DATA BASE BY OCEAN AREA/INSTRUMENT

Instrument	Atlantic	Mediterranean
BT	23 808	16 756
NC	11 473	9 289
XBT (SACL)	171	77
STD (SACL)	33	156
TOTAL	35 485	26 278

These totals include only those data immediately available on mass storage, but other as yet unused data are held on magnetic tape for inclusion in the data base if need arises. These are:

a. Mechanical-BT data in the Mediterranean, as supplied by the US National Oceanographic Data Center (NODC).

b. Station data in the eastern N. Atlantic Ocean, as supplied by the International Council for the Exploration of the Seas (I.C.E.S.).

The total available data are summarized in Table 3.

TABLE 3

TOTAL AVAILABLE PROFILES

Data available immediately	61 763 profiles
Data available if required	119 327 profiles
TOTAL	181 090 profiles

A large amount of SACLANTCEN-recorded XBT and STD data in the Mediterranean, particularly in the area close to the Island of Elba have yet to be compressed and entered. In addition, data collected during the multi-national TOURBILLON experiment in the Southwestern Approaches to the English Channel will shortly be included.

2.3 Description of Data Records

2.3.1 General

Each profile is stored using the MFS in two distinct data areas: a descriptive area containing the header or dictionary data and a data area containing the actual profile, thus allowing individual access to either area. This is an advantage for many applications in which only the header data are used (e.g. in spatial distribution charts).

2.3.2 Header Area

This is a fixed-length record area of 28 computer words, whose contents are detailed in Table 4.

Word 1 contains one of three possible parameters:

a) Mediterranean records not collected by SACLANTCEN use a domain number. These domains (Fig. 7) have been delineated by virtue of differing characteristics of oceanographic and/or bathymetric features. They were created for a specific analysis <2> and have since been used as a spatial structure on which to base climatic/oceanographic research studies in the Mediterranean.

b) Atlantic records not collected by SACLANTCEN use the consecutive number of the profile within their own Ins/MSQ/DSQ/Month group (see Sect. 1.2).

c) All SACLANTCEN records use a cast number identifier; this is a cruise-related, sequential event identification, consisting of the Julian day (three characters) and a cast number (three characters).

The Marsden square and one degree-square identifications in Words 2 and 3 are as already explained in Fig. 3.

Country codes of Word 4 are those of the International Oceanographic Commission, as listed in App. A. Ship codes (Word 5) are assigned nationally by the relevant oceanographic authorities. For example, the SACLANTCEN research vessel "R/V MARIA PAOLINA G." which is registered in Italy is classified by country code 48 and ship code Ø5.

Words 6 to 14 are self-explanatory.

The quality code (Word 15) is given as a result of various analyses by SACLANTCEN to identify profiles that must be regarded as doubtful. These data are flagged so that future analyses may, if necessary, avoid their inclusion (see Sect. 2.4 for further details).

Meteorological data are included when available (Words 17 to 25), being encoded using WMO (World Meteorological Organization) standards.

For SACLANTCEN records only, Word 26 permits the inclusion of near-surface temperature data measured either by the engine-intake thermometer or, in later records, by a thermograph mounted in an industrial hard hat ("capello") towed alongside the ship. This latter method has proved to be of considerable value in the validation of XBT sea-surface temperature values at SACLANTCEN <7>.

Also for SACLANTCEN records only, Words 27 and 28 provide a cruise identifier that serves as an internal reference identification for linking data measured during a particular experiment. All "events" or casts made from SACLANTCEN vessels are logged on a standard "Oceanographic Cruise Dictionary" (Fig. 8). The majority of these parameters are recorded immediately on board, the remainder being recorded later at SACLANTCEN after the track navigation has been checked.

TABLE 4

DESCRIPTIVE AREA PARAMETERS

Word	Contents	Comments
1	Either: (a) Oceanographic domain (b) Cons. No. with one MSQ/DSQ/Month (c) Cast Identifier	 Mediterranean only Atlantic only SACLANTCEN data only
2	Marsden Square (MSQ)	MSQ-100
3	1° Square (DSQ)	
4	Country code	I.O.C. code
5	Ship code	
6	Latitude	1/10 minutes
7	Longitude	1/10 minutes
8	Hemisphere	West = 1, East = 2
9	Year of observation	Year - 1900
10	Month of observation	
11	Day of observation	
12	Time of day	Greenwich [HHMM]
13	Maximum depth of probe	metres
14	Number of scans or levels in profile	
15	Quality code	'M' = acceptable 'D' = doubtful
Meteorological data		
16	Water depth	metres
17	Cloud amount	oktas
18	Wind direction	360°
19	Wind speed	knots
20	Air temperature (dry)	0.1°C
21	Air temperature (wet)	0.1°C
22	Air pressure	mbar
23	Weather	WMO code 4501
24	Wave period	seconds
25	Wave height	0.5 metres
For SACLANTCEN data only, where available		
26	Near surface temperature	Intake or towed "capello" × 0.1°C
27	Cruise identifier	up to 12 alphanumeric characters
28	Cruise identifier	

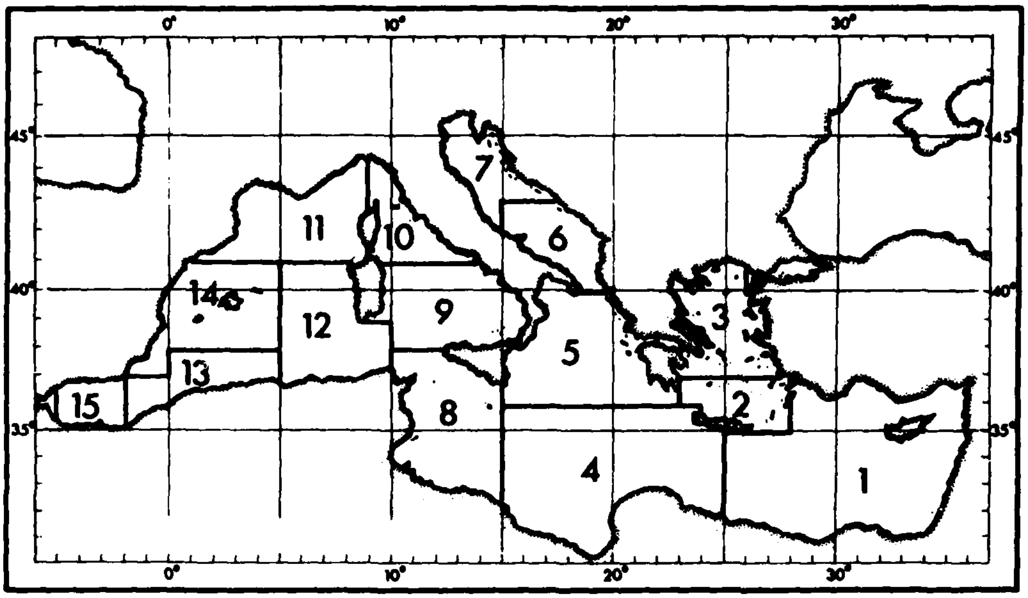


FIG. 7 MEDITERRANEAN SEA DOMAIN DELINEATION

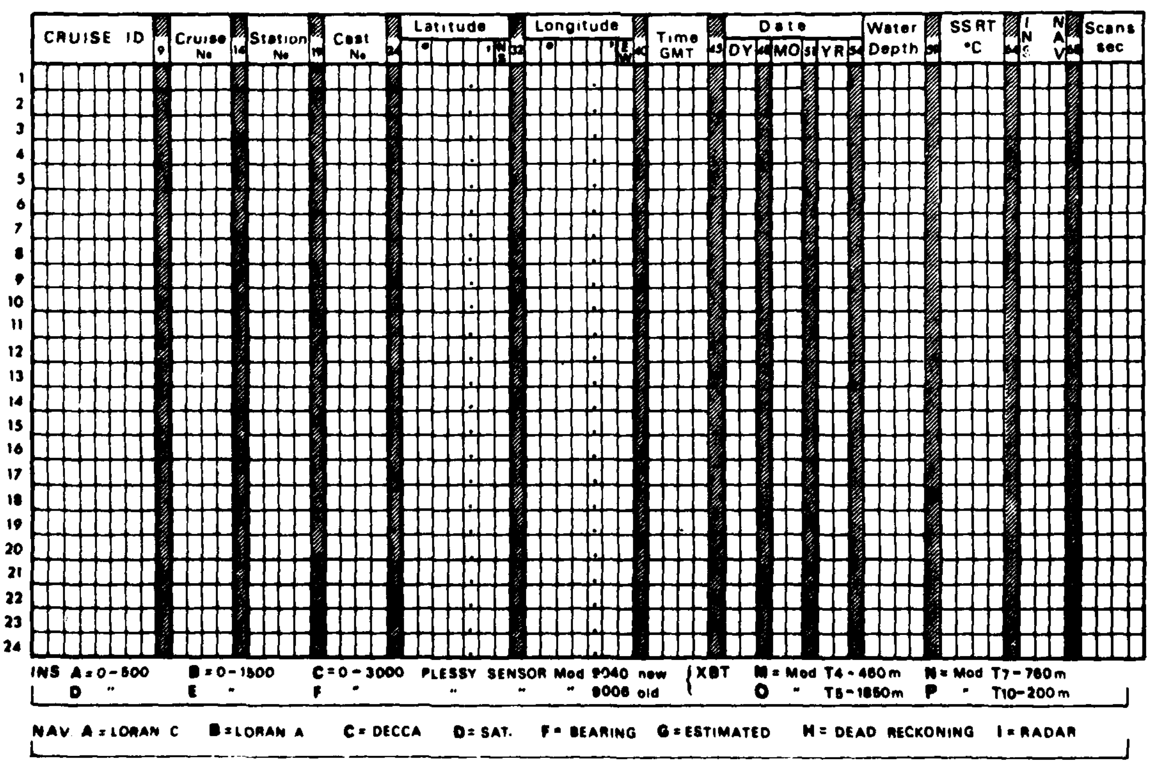


FIG. 8 SACLANTCEN OCEANOGRAPHIC CRUISE DICTIONARY

2.3.3 Data Area

This is a variable-length record containing a matrix of the scans or levels in the profile, using the following sequence of parameters:

Depth (or pressure)
Temperature
Salinity (or conductivity)
Sound speed
Type

The length of the record is therefore the product of the number of parameters and the number of levels (Word 14 of the header area described in Sect. 2.3.2.). The parameters stored for each instrument are as follows:

Mechanical BT, XBT	Depth/temperature
Nansen casts	Depth/temperature/salinity/computed sound speed
STD/CTD	Depth or pressure/temperature/salinity or conductivity/in-situ sound speed.

The data are recorded in different ways, depending on the originator or the instrument used.

All manual BT data and the XBT data not collected by SACLANTCEN are stored by the values at significant, visually-selected points, using manual or semi-automatic methods and line-follower equipment <8, 9>.

Nansen cast data are stored by the values at water-bottle depths and interpolated "standard" depths. The former are labelled as type 3, the latter as type 6, which is an internationally accepted method.

For XBT data collected by SACLANTCEN, two methods are employed. Those recorded prior to 1971 were digitized at significant points using a pencil-follower to read the analogue records. With the implementation of an on-board on-line digitization system in 1971 all data are now recorded direct on magnetic tape <10> for later analysis on SACLANTCEN's UNIVAC-1100/60 computer <11>. The edited profiles are subjected to a compression algorithm <12> developed to reduce the maximum number of scans to within a user defined limit. This number (125 for XBT data) has been chosen to constrain the size of the XBT data within reasonable limits, allowing climatic and mesoscale phenomena to be studied. Microscale features are obviously lost by compression, but for analyses of such features, the original data tapes are readily available.

For STD data collected by SACLANTCEN <13>, a 2-decibar averaging process is employed. As the STD probe is lowered by the on-deck winch, both motion-induced pitching and rolling of the ship and the variable winch speed manifest themselves as pressure inversions or "loops" and pressure increment variations in the probe descent path. An algorithm has been developed at SACLANTCEN to average all scan values between successive 2-decibar levels and assign the resultant mean value to the greater pressure of the averaging window. The pressure values are converted to depth <14> before storage in the data base. This process is performed by the acquisition computer system (HP 21MX) after the traces have been "cleaned" and edited for instrumental error, digitization error, salinity spiking in high temperature gradient layers, etc.

2.4 Doubtful Data

As described in Sect. 2.3.2, a quality code is recorded as Word 15 of the header area.

This code is normally 'M', signifying that the data are acceptable. However, during the course of various analyses a number of the profiles have been found to be erroneous to a certain degree. It would be presumptive to say that data that had passed many rigorous tests are incorrect, but our experience shows that many positions are wildly inaccurate, and detailed oceanographic analyses have revealed extremely dubious parameter values. In an analysis that used Mediterranean Nansen-cast data <2>, for example, 2% of the data were found to be erroneous or outside reasonable statistical boundaries and had to be rejected from the analysis.

For these reasons, a routine known as MARKD has been developed to flag doubtful profiles with a character 'D' in Word 15 of the header area. All application routines may then test this field and, at the user's discretion, include or exclude the profile from the data search.

3 DATA ENTRY AND FORMAT CONVERSION

3.1 General

The majority of the data in the base have been supplied by outside organizations. The problem of format conversion therefore has had to be overcome with each data set.

However, to avoid such problems in future, data will, whenever possible, be solicited either from organizations whose format has already been handled or from organizations who can supply data in the NATO Standard Oceanographic Data Exchange (NODEF1) format (given in App. B). Several standard format conversion routines have been written to transfer data into the base from the major sources; each will be briefly described. In addition, the entry of SACLANTCEN recorded digital data is described, as far as the system has at present been developed.

3.2 Data in US Oceanographic Office Format

This is written in UNIVAC Field Data code as 20-word, blocked records, encoded character by character in the fixed format shown as Fig. 9. A routine, knows as LOADUSHO, unpacks these characters according to the type of data. The BT data are introduced by a six-word header record, followed by the entire depth profile and then by the entire temperature profile, the number of points on the profile being stored in three characters of Word 4 (Fig. 9a). The station data are written in the same format except for Word 5, (Fig. 9b) in which two characters are used to indicate the number of points on the profile and the righthand character is used to indicate the number of parameters. The header is followed by the entire depth profile and then by each of the following (if present): temperature, salinity, sigma-t, sound speed. After conversion the sigma-t values are discarded and the remainder converted into SMODS format. The US Oceanographic Office format has now been converted successfully on a number of occasions without problems.

CHARACTER

	WORD	1	2	3	4	5	6
DICTIONARY	1	MARSDEN SQUARE			BLANK	1 DEGREE SQUARE	
	2	LAT (DEG)		LAT (MIN)		TENTHS OF MIN	N OR S
	3	LONG (DEG)		LONG (MIN)		TENTHS OF MIN	E OR W
	4	MONTH		DAY		YEAR	
	5	HOUR (GMT)		TENTHS OF HOUR	NUMBER OF POINTS ON PROFILE		
	6	MAX DEPTH (METRES)				NUMBER OF DATA RECORDS	
DEPTH	1	DEPTH N 1 METRES (INTEGER)				BLANK	
	2	DEPTH No. 2				BLANK	
	⋮						
	20	DEPTH No. 20				BLANK	
TEMP	1	TEMP No. 1 (DEG)		DECIMAL POINT	TEMP No. 1 (TENTH DEG)	BLANK	
	2	TEMP No. 2 (DEG)		DECIMAL POINT	TEMP No.2 (TENTH DEG)	BLANK	
	⋮						
	20	TEMP No. 20 (DEG)		DECIMAL POINT	TEMP No. 20 (TENTH DEG)	BLANK	

FIG. 9(a) USHO BT DATA FORMAT

CHARACTER

	WORD	1	2	3	4	5	6
DICTIONARY	1	MARSDEN SQUARE			BLANK	1 DEGREE SQUARE	
	2	LAT (DEG)		LAT (MIN)		TENTHS OF MIN	N OR S
	3	LONG (DEG)		LONG (MIN)		TENTHS OF MIN	E OR W
	4	MONTH		DAY		YEAR	
	5	HOUR (GMT)		TENTHS OF HOUR	NUMBER OF POINTS ON PROFILE		No. OF PARAMETERS
	6	MAX DEPTH (METRES)				NUMBER OF DATA RECORDS	

FIG. 9(b) USHO STATION DATA FORMAT

3.3 Data in UK Hydrographic Office Format

The major stumbling block in transferring data from this format has been that of the host computer. Because the UKHO data base is implemented on an ICL-1900 series computer, data supplied to SACLANTCEN have first to be transferred to UNIVAC field-data code by another UK MOD computing facility.

The format uses variable-length records, the first 87 characters of which are "header" data (Table 5), followed by a variable number of six-character pairs of depth and temperature with a "negative depth" terminator. On conversion, a number of the "header" fields are discarded, retaining only those listed in the SMODS dictionary (Table 4), including the meteorological data. A conversion routine, known as "LOADUKBT", handles all UNIVAC-translated tapes of the ICL-formatted data. In future if the quantity of data exchange increases, an in-house ICL-to-UNIVAC conversion program will be activated to read the ICL tapes direct.

3.4 Data in NATO Oceanographic Data Exchange Format (NODEF1)

This format has been developed for the exchange of data between NATO and National oceanographic data centres. If this format is unilaterally approved, data exchange will be reduced solely to the use of two programs: one to write data in NODEF1 format and the other to read and convert from NODEF1 format. The latter is achieved at SACLANTCEN with the LOADNODEF1 routine, which extracts from the NODEF1-written data those parameters needed for the SMODS data base and writes them in the required format.

The NODEF1 format is fully described in App. B.

3.5 SACLANTCEN Digital Data

3.5.1 XBT Data

The analysis of XBT data at SACLANTCEN described in Sect. 2.3.3 is summarized in Figs. 10(a) and (b).

During the final phase of the compression, the interactive software asks if the user wishes to store the data in the base. If so the system takes care of file assignment, data formatting, etc. and reports its successful completion. Thus the execution of the XBTEDIT program also takes care of XBT entry into the data base, if required. This process has been carried out on a number of data sets.

3.5.2 STD Data

The analysis of STD data at SACLANTCEN was described in Sect. 2.3.3.

Subsequently, these data are transferred to the UNIVAC where a program known as LOADSTD reformats the data and writes it into the base together with the associated dictionary data selected from the SACLANTCEN Oceanographic Cruise Dictionary file.

TABLE 5

HYDROGRAPHIC OFFICE BATHYTHERMOGRAPH RECORD FORMAT

No. of Characters	
2	Spaces
1	Data-Use Code
1	File Code
5	Marsden Square and 1° Square
1	Space
2	Month
4	Year
2	Day
2	Hour
2	Minute
2	Country Code
2	Ship Code
4	Slide Number
3	Latitude - degrees - provision for negative character (=S)
3	Latitude - minutes - provision for negative character (=S)
4	Longitude - degrees - provision for negative character (=W)
3	Longitude - minutes - provision for negative character (=W)
1	Quadrant (ICES code NOT WMO)
4	Depth
1	BT Instrument
1	Cloud Amount
2	Wind Direction
2	Wind Speed
4	Air temperature (dry) – provision for negative field
4	Air temperature (wet) – provision for negative field
4	Pressure
1	Weather
2	Wave Period
2	Wave Height
1	Sea-Surface Instrument
4	Sea-Surface Reference temperature – provision for negative field
3	TCS – provision for negative field
1	Type
1	Grade
1	Hydro Station
1	Units
1	Method
3	Adjustment applied to temperature data - provision for negative field
3	Depth — Repeated up to a maximum of 90 readings
3	Temperature — Repeated up to a maximum of 90 readings
3	End-of-record Symbol i.e. 99

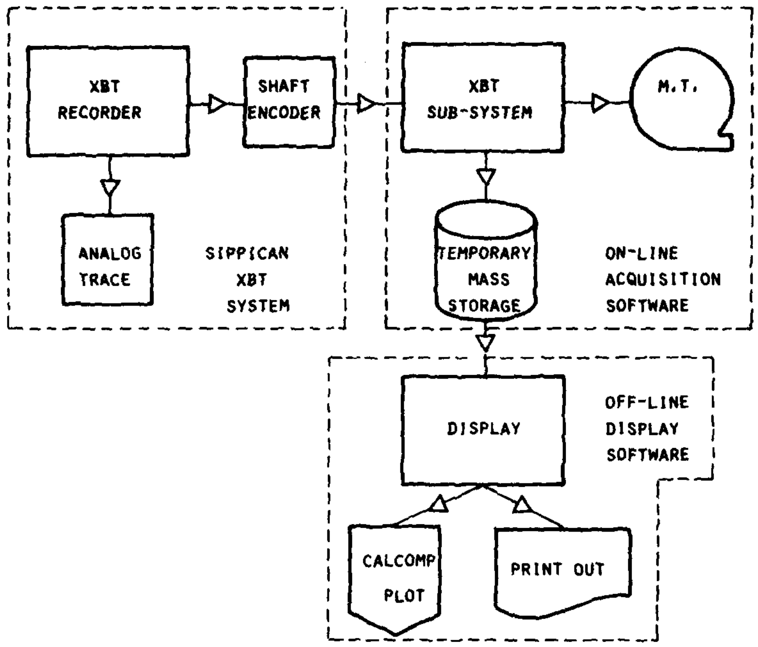


FIG. 10(a) SACLANTCEN XBT DATA ACQUISITION SYSTEM

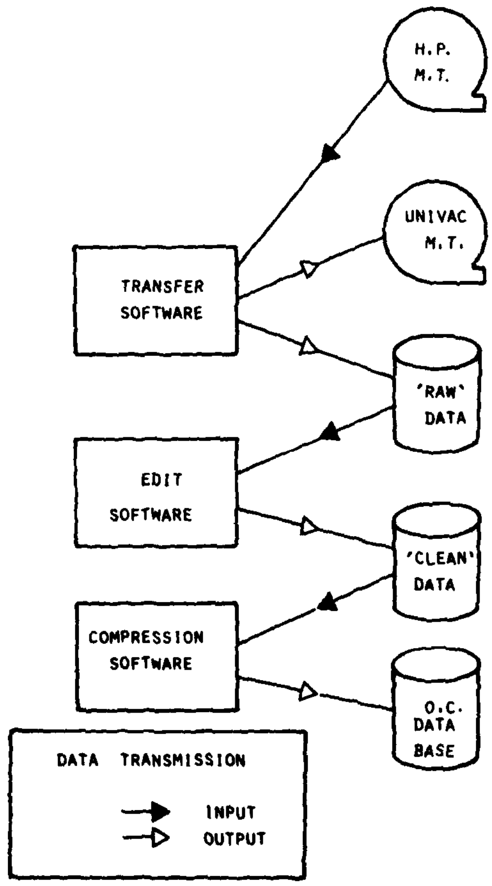


FIG. 10(b) SACLANTCEN XBT PROCESSING SYSTEM

CONCLUSIONS

A random-access data base of oceanographic data has been established to provide historical environmental data for the use of SACLANTCEN's oceanographic, acoustic and operational research projects. The base includes data acquired from outside organizations and by SACLANTCEN research vessels.

This memorandum has discussed those factors that affected the design of the data base within the limits of available hardware and software. It has continued by describing the various types of data stored in the base, how they are stored and how newly-acquired data can be introduced in future. A second memorandum <3> describes how the data base is accessed and shows various "standard" routines with which to display and analyse the data.

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A P P E N D I C E S

APPENDIX A

INTERNATIONAL OCEANOGRAPHIC COMMISSION NUMBERS OF THE MEMBER COUNTRIES OF ICES <A.1>

Belgium	11
Canada	18
Denmark	26
Finland	34
France	35
German Democratic Republic	96
Germany, Fed. Republic of	06
Iceland	46
Ireland	45
Netherlands	64
Norway	58
Poland	67
Portugal	68
Spain	29
Sweden	77
Union of Soviet Socialist Republics	90
United Kingdom of Great Britain and Northern Ireland	74
United States of America	31

REFERENCE

A.1 CONSEIL INTERNATIONAL POUR L'EXPLORATION DE LA MER, Service Hydrographique. Manual on ICES oceanographic punch cards, 4th edn., Copenhagen, ICES, 1979.

APPENDIX B

NATO OCEANOGRAPHIC DATA EXCHANGE FORMAT (NODEF1)

The following description of the NODEF1 format is taken from <B.1>.

An observation will consist of multiple card image records of various formats. A description of the various record types follows. Detail of the record formats form the remainder of this annex.

Record Type	Name	Detail
0	Source	Originator's observation identification number, date, time, position, type of observation, details of processing methods.
1	Meteorology	Meteorological conditions prevailing at the time of the observation.
2	Comments	Any other information not catered for in the format
3	Bathythermograph	Depth/temperature values, usually from BT instruments.
4	Velocimeter	Depth/sound speed values taken by velocimeters.
5	Serial (observed level)	Depth/temperature/salinity/ sound speed values at an observed depth - usually water bottle or STD type data.
6	Serial (interpolated level)	Depth/temperature/salinity/ sound speed values interpolated from observed level data.

All record types except type 0 are optional, although an observation must contain at least one record of type 3, 4, 5 or 6. All record types except types 0 and 1 may be used a number of times in each observation.

An observation may not contain type 3 or 4 records if it contains type 5 or 6, and vice versa.

REFERENCE

B.1 Annex A to Ltr from Hydrographic Department, Ministry of Defence, Taunton, Somerset, 27 March 1980 (ref. H1402/80).

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